SCIENCE

NEW YORK, NOVEMBER 17, 1893.

LETTERS TO THE EDITOR.

***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

(For other letters see page 276.)

POSTAGE ON NATURAL HISTORY SPECIMENS.

IT has always been recognized that scientific research is greatly furthered by the exchange of the various objects with which that research is concerned. For the transmission of objects of Natural History from one country to another, the mails have offered a cheap, speedy and reliable means. Heretofore, through the laxity with which the regulations on the subject have been enforced, it has been possible to enter such objects in the mails of the Universal Postal Union as samples of merchandise and under the rates of postage therefor. From official information lately received from the Post Office Department of the United States it appears that such a rating is entirely unauthorized by existing provisions, and that objects of Natural History may be mailed to countries of the Union only at the rates required for letters. The United States Post Office Department also stated that it had recently submitted a proposition to the countries composing the Postal Union, to modify the regulations so that such specimens might be received into the mails at the same rates as samples of merchandise, but that a sufficient number of those countries had voted against the proposition to defeat it.

This Academy has therefore resolved to address the various scientific bodies, with which it is in communication in those countries whose governments have voted against the proposition, and to request those scientific bodies to memorialize their respective governments in favor of the same.

The Governments of Austria, Bolivia, British India Canada, Germany, Great Britain, Guatemela' Hungary Japan, Norway, Portugal, Russia, Spain, Sweden, Tunis, Uruguay and Venezuela having voted in the negative, this Academy respectfully requests the favorable consideration of this question by scientific societies, and begs that they take such steps as they deem advisable to inform the postal authorities of their respective governments of the manifest advantages to scientific research which would result from the adoption of the proposed modification, and to request those authorities to take such steps as may result in the adoption of the same.

The letter rate for postage (Universal Postal Union) is ten times that required for samples of merchandise; such a rate for specimens of Natural History is virtually prohibitive.

This Academy would respectfully urge upon scientific societies prompt action on this matter if it meets with that approval which we so strongly desire.

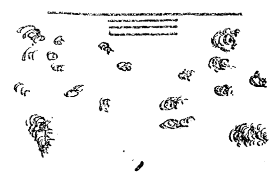
ISAAC J. WISTAR, President.
EDW. J. NOLAN, Recording Secretary.

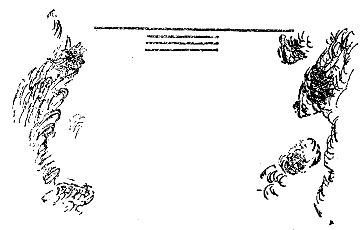
The Academy of Natural Sciences of Philadelphia, November 14.

THE PICTURE IN THE LANDSCAPE.

THE inquiry by Waldo Dennis, on page 213, into the causes of the unlike impressions which one receives from a given landscape and from a painting of it, seems to me to explain the subject admirably. He supposes that the reason why the picture appeals to us more than the landscape does is because the picture is condensed and the mind becomes acquainted with its entire purpose at once, while the landscape is so broad that the individual objects at first fix the attention, and it is only by a process of synthesis that the unity of the landscape finally becomes apparent. This is admirably illustrated in photographs. One of the first surprises which I experienced when I began the use of the camera was the discovery that very tame scenes become interesting and often even spirited in the photograph. But there is something more than mere condensation in this vitalizing and beautifying effect of the photograph or the painting. Individual objects are so much reduced that they no longer appeal to us as distinct subjects, and however uncouth they may be in the reality, they make no impression in the picture. The thin and sere sward may appear rather like a closely shaven lawn or a new-mown meadow. And again, the picture sets a limit to the scene, it frames it, and thereby cuts off all extraneous and confusing or irrelevant landscapes.

All these remarks are enforced in the æsthetics of landscape-gardening. It is the artist's one desire to make pictures in the landscape. This is done in two ways—by the form of plantations and by the use of vistas. He will throw his plantations into such positions that open and yet more or less confined areas of greensward are presented to the observer at various points. This glade-like opening is nearly or quite devoid of small or individual





objects, which always destroy the unity of such areas and are meaningless in themselves. The two sketches illustrate my meaning. The upper one is a fair diagram of the average front-yard. It is full of individual trees and bushes, or groups, and the eye is carried from object to object, while the entire yard makes no quick appeal to the mind. One is pleased only with the kinds of plants which he sees. The lower sketch presents a definite area at once to the observer, and the individual plants are of minor importance. Here is a landscape —a picture; there was a nursery.

A vista is a narrow opening or view between plantations to a distant landscape. It cuts up the broad horizon into portions which are readily cognizable. It frames

portions of the country-side. The verdurous sides of the planting are the sides of the frame; the foreground is the bottom and the sky is the top. L. H. BAILEY.

Ithaca, N. Y.

THE ORIGINAL TYPE OF CORN.

REFERRING to the article by Mr. Hershey in a recent number of *Science*, there are six types of corn, viz.: dent corn, flint corn, pop corn, sweet corn, soft corn and pod corn. Each of the first five has well marked structural differences in the kernel. Dr. Sturtevant proposed to distinguish these differences by calling these types agricultural species. The kernel of the pod corn does not present structural differences markedly unlike that of the flint corn, and probably under proper conditions would take on the characters of dent corn, but this type differs from all the others in that each kernel has a husk of its own, besides the usual husk that covers the ear; hence the name pod corn.

It has been claimed that this type of corn has been found growing wild in the Rocky Mountains and one observer reports it from Brazil. Just how authentic these observations are I do not know. I have some doubts about them, but be that as it may, this type has a special interest to Mr. Hershey in that it is quite customary for it to have fairly well-formed ears in the tassel, each kernel being covered with husks, and the whole ear more or less covered with a husk, although the outer husk is generally rather slight for reasons which will appear later on.

The transition from corn bearing its seeds in the tassel to that having ears at the joints is not hard to imagine, when we recognize that each joint has a tendency to produce an ear or throw out a sucker. Suckers, that is, stalks of smaller size than the main stalks and frequently barren, result from the lower joints of the main stalk, and ears from the upper ones when anything develops from these joints.

Now if we assume it likely that originally each joint threw out a sucker, which at that time would be a stalk bearing at its top both staminate and pistillate flowers, it is not difficult to see that these suckers might easily be modified into ears, that is, stalks bearing only pistillate flowers. Obviously, in the process of natural selection, those plants would be most likely to survive which had the most pollen in the upper tassel, or, in other words, in the tassel of the main stalk, because the pollen tends to descend. On the other hand, the ovaries on tassels lower down on the suckers would be more likely to be fertilized by virtue of their position. It would thus come about that there would be less and less ovaries produced on the upper tassel and less pollen on the lower ones, until we had only pistillate flowers below and staminate ones above.

There are varieties to-day, such as Blount's Prolific, which have six to eight ears upon a stalk; but these varieties are almost uniformly inferior to those varieties with but one ear per stalk for the production of grain. We can readily understand, therefore, that man in semi-civilized times early recognized that, for the production of grain, the only part of the plant then used, those plants with the fewer ears were superior, and hence selected such until the one-eared varieties resulted.

All varieties tend to sucker, more or less, when planted thinly; that is, to produce more stalks than there were seeds planted. The supernumerary stalks come from the joints at the base of the main plant. If you plant four kernels of Brazillian flour-corn, a variety belonging to the soft corn type, you will get, under normal conditions, about twelve stalks of corn. About three joints of each main plant produce stalks or suckers. While suckers frequently produce ears, they have a tendency to be barren, and they are more prone than the main stalks to produce corn in the tassel, although the production of corn in the tassel is more common generally than Mr. Hershey evidently supposes.

All ears are borne at the end of stalks, much more reduced in length than those we commonly call suckers. Yet the length of these stalks varies greatly in different varieties, and practical men prefer, other things equal, the ear with the shorter stalk or shank. Of course, in early times those plants having the grain on the shorter stalks would be selected, both because the stalk would be of no possible advantage and because the shorter the stalks the more completely the ear would be covered with husk, due to the fact that the husks are but slightly modified leaves. Indeed, this may have come about from natural selection. if corn ever in this form grew in a state of nature, due to the fact that the husk is a protection from its natural enemies, and hence the more husk on the ear the less would be the liability of the seeds being destroyed, hence the greater likelihood of such plants being perpetuated. THOMAS F. HUNT.

Ohio State University.

—Immediately following the World's Congress on Horticulture at Chicago in August last, a series of meetings was held to consider the advisability of organizing a horticultural society which shall include every country of the globe. After much discussion, in which many eminent men from various parts of the world engaged, the World's Horticultural Society was organized and the election of the three general officers was held on the 25th of August. This new society is designed, in the language of the constitution, "to promote correspondence and to facilitate exchange of plants and information between the countries of the world. This society can coördinate and extend the work of all existing societies, compile statistics, promote legislation and education, prepare correspondence directories, diffuse all the latest information from the various parts of the globe, consider means of transportation and facilitate the exchange of varieties and every commodity in which pomologists, viticulturists, florists, vegetable gardeners and other horticulturists are interested. The society will probably meet occasionally at the various International Exhibitions, upon which occasions, also, it can greatly aid in procuring exhibits from all parts of the world. The Society now requests the earnest and early support of its friends. The Vice Presidents of the various countries will be announced soon, and the organization will then be quickly completed. The Society needs the co-operation of every enlightened horticulturist and every important horticultural organization. Prosper J. Berckmans, President, Augusta, Georgia, U. S. A.; Henri L. DeVilmorin, Vice President, No. 22 Avenue de la Bourbonnais, Paris, France; L. H. Bailey, Ithaca, N. Y., U. S. A., Secretary-Treasurer for the United States, and temporary Secretary-Treasurer at Large.

—The American Academy of Arts and Sciences, at a meeting held in Boston on Nov. 8, voted to grant—from the C. M. Warren Fund for Encouraging Chemical Research—the sum of $300 to Professor C. F. Mabery, of Cleveland, Ohio, in aid of his investigations on the American sulphur petroleums.

—Another of Robert S. Ball's popular books on Astronomy, entitled, "In the High Heavens," is to be published soon by J. B. Lippincott Company. It will be profusely illustrated by drawings in the text and a number of full-page colored plates.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

RECENT DISCOVERIES IN NORTHEASTERN NICARAGUA: GRANITE HILLS, MOUTONNÉD RIDGES AND GOLD-CONTAINING LODES OR REEFS, AND LEADS OR PLACER MINES.

BY J. CRAWFORD, RIO WANQUE OR COCO, AT SAN RAMON, NICARAGUA.

DURING the past year, commencing August, 1892, ten months of nearly continuous exploration have been spent by the author over an area of some 10,000 to 12,000 square miles in the uninhabited wilderness and jungle that cover a large part of northeastern Nicaragua, examining the geology, minerology, and flora existing in great attractiveness and variety in that part of the country. Among the numerous interesting features and peculiarities discovered or noted that are worthy, from both a scientific and economical point of view, of a more special description than was given of them in my paper, "Hydrographic Area of the Rio Waukey, or Coco-Nicaragua," published in *Science*, in April, 1893, are the following:

(a) The granite outbursts exposed on the tops of oval-shaped *Cerros* or mountains, and which also form the *Cima del Cerro* and longer axis of long, high, mountain ridges.

(b) The numerous moutonnéd ridges and lateral and terminal moraines, in series that evidence the former existence of a glacial epoch which covered an area of several thousand square miles in Nicaragua with a flow of glacial ice.

(c) The erosion-sculptured *Cerros* that intervene between the granite hills and moutonnéd ridges, composed of debris denuded from both the nearby granite mountains and materials from mountain ranges found further to the southward.

(d) The reefs or lodes (many of them auriferous) and dykes (of diorite) in which auriferous quartz veins are discovered piercing the mountains and ridges parallel to the length of the series of the system; and also the Post-Pliocene leads of drifts of gravels and boulders. Gold is found exposed in the banks at sides of streams, that appear to extend through the erosion-sculptured hills near their base, and also the alluvial leads, drifts of gravels, gold, etc., found in the channels of the creeks and in strata in the lower parts of valleys.

(e) The composition and fertility or non-fertility of the soil and its fitness, in places, for the vigorous growth of certain kinds of trees or plants, also the peculiar formation where groves of some kinds of valuable trees were found growing to large dimensions.

(f) The apparent geological history of the granite hills, dykes, reefs or lodes, moutonnéd ridges, erosion-formed ridges, and of the leads or placer mines.

The region in northeastern Nicaragua chosen for description in this paper as typical of a few others in that part of the country is a wilderness unoccupied by man[1]; and although this locality is a part of Nicaragua, neither the government nor the citizens of that country have even a vague conception of its importance and its truly great undeveloped wealth in valuable minerals and metals, timber, and agricultural lands. The centre of this chosen locality is about longitude 85° W. (from Greenwich) and latitude 14° N., and embraces the headwaters of Nawawass, Wilson, Loccus, Umbra, Waspoopoo, Moorawass, Sangsang and Daka Creeks, and Wasspook River, confluents to Rio Waukey, or Coco River, and also the line of *Cerros*, about sixty miles long, just south of the Wasspook River.

The granite masses appear to be in two parallel lines of elevation, but connected together as one mass and composed of rock of the same mineral composition, usually amphibole, syenites (with and without quartz), and also protogene and plagioclose varieties appear most numerous. The cooling has permitted the crystallization of the minerals so similarly at about the same depth from the surface (isogeothermal zone) in each line of ridges, as to indicate that the two exposed lines were of the same mass and lowering in temperature at the same rate. The granite has been exposed by erosion, and the hills, also, have been eroded deeply at many places, and the rocks have, at several places observed, become disintegrated and decomposed, *in situ*, to depths of five to twenty feet. The exposed granites are in series of spurs and ridges that extend northeastwardly for about ninety miles from the Barbar Mountains (at the southeastern termination of the Matagalpa system of mountains), and form an angle of about 120° with the southeasterly and northwesterly direction of that mountain system, which is composed largely of Archean and Silurian era rocks.

The northeastern termination of these granite spurs and ridges is near to the confluence of the Rios Wasspook and Wauque, at a distance of about one hundred miles west from the Carribbean Sea, on the eastern coast of Nicaragua, and about the same distance south from that sea on the northern coast of Nicaragua. The forces causing this upheaval of granite appear also to have fissured the superimposed and adjacent systems of rocks for many miles[2]. These fissures are now filled by deposition of minerals and metals from hot solutions, and are now reefs or lodes, containing quartz, gold, metallic ores, and other minerals. Near the northern termination of these granite ridges were found patches, of varying size, of auriferous sands, gravels, clays, and boulders—detritus transported by water from the denuded granite hills and from ranges in the Matagalpa system of mountains. These deposits of detritus increase in size northwardly, until covered northwardly by the sands and mud composing the delta of the Rio Wauque; and on the west the deposits of detritus were in large quantities, and subsequently have been sculptured by erosion into hills and ridges; also found resting in small areas on the granite ridges are boulders in size from a few pounds to over two hundred pounds each, of varieties of bluish glaucophanyte, or hypers-

[1]Recently two or three Latin-Americans have, in a crude way, simulated placer-mining work in one or two of the mineral localities. They appear hopeful and cheerful.

[2]It is very difficult, frequently impossible, to trace the extent of the outcropping of lodes or reefs, and even of dykes, in this wilderness of dense growth of trees, vines and plants and a deep soil.

thenyte, or augyte, or trachyte rocks, that appear thickly sprinkled with pyrites and magnetic and titanic iron ores; these boulders were weathered toward their centres from one to three inches, and were found to be auriferous—in some instances, highly so; they differ in composition and color from the hornblende and orthoclase granite-mass forming the axis and serrated ridges of the hills, also from the boulders mixed with the patches of clay, sands, gravels, and boulders that are found to the southward on these granite hills and ridges. This filling up of former existing valleys with the materials worn off, in part, from the granite ridges, evidences a subsidence in that locality at the time, and this evidence is supported by the existence, to the north of the granite hills and between them and the Wauque, or Coco, River, of a disconnected line of limestone; on one depression of this limestone a deposit of the auriferous clays, sands, gravels, and boulders was found. The eroding into hills and valleys, as they at present appear, composed of the mass of detritus of disintegrated granites, etc., is evidence of a subsequent elevation of that entire region and the completing of one oscillation of subsidence and of re-elevation there.

The moutonnéd ridges extend for about sixty miles in a series of parallel oblong ridges northeastwardly from near the base of the tall Barbar and Peña Blanca Mountains, that at present have an altitude of over 7,000 feet above the Caribbean Sea. One of the projecting lines of moraines extends further northward, and is about ninety miles long until it terminates at a dyke, on whose sides auriferous gravels are found, in which the Rio Wauque has cut its channel at San Ramon.

This system of moutonnéd ridges extends to a width eastward and westward of about twenty-five miles, and has at present an altitude above the creeks at its base of from 70 to 400 feet. They were found to be composed most generally of unstratified clays, sands, gravels, and boulders; occasionally, however, these materials are partly stratified and partly assorted. The enclosed boulders are of various sizes, from ten pounds to several tons weight, and are usually angular or sub-angular, becoming oblong and oval as the series of moutonnéd ridges extend northward, *i. e.*, towards the Wauque River, and are composed most generally of fragments of auriferous quartz, granites, syenites, hornblendic feldspatic rocks.

These moutonnéd ridges have been denuded and eroded by the very energetic and potent meteorological forces in this locality, until numerous large boulders have been displaced and lie on the sides and at the base of the ridges; also numerous gulleys score deeply the sides of these ridges, and deep ravines or channels of the flowing creeks separate many of them from each other. These moutonnéd ridges are unquestionable evidences of a glacial epoch and of a long-continued glacial flow *at this low parallel*—only 14° north from the equator[3]—which covered quite a large part of the present existing narrow divide of land (containing about 48,000 square miles) between the Pacific Ocean and the Caribbean Sea. Adjoining the granite hills on the northward and northwestward, often between the moutonnéd and the granite ridges, are a number of erosion-sculptured hills that have been carved out by the draining forces attending the elevation of lands in that locality, and evidence that elevation, and subsequently by meteoric forces. These hills of erosion are composed of the detritus of rocks transported by water from the southeastern ending of the Matagalpa system of mountains (a distance of seventy to eighty miles southwest), and of materials eroded from the adjoining and nearby series of granite hills; the materials composing them have been cemented and concreted into semi-hard rocks and conglomerate masses of clastic rocks. The altitude above the Caribbean Sea of many of these granite ridges, erosion-formed *Cerros* and moutonnéd ridges, is from 1,000 to 3,500 feet; all are covered with a dense growth of large trees, or, in some places on the erosion-formed ridges, covered with a jungle of trees, bamboos, vines, and other vegetation.

The reefs, or lodes, strike east of north and west of south, parallel to the long axis of the ridges and mountains, and those discovered usually dip at an angle of about 120° south. They are from 6 to 30 inches wide, and usually appear to be rich in gold and in metallic sulphides and arsenides. The reefs at the granite ridges are parallel with those ridges, and found at the contact between the granite and superimposed rocks (though some appear to be in the granite) as principal lodes, from which extend at various angles into the adjacent erosion-carved *Cerros* many fissures containing the oxide of metals, gold, sulphides, etc. Some few of these fissures appear to continue northwardly into the moutonnéd ridges; but this was not verified, because of the deep soil and dense undergrowth that covers the surface of the hills and valleys at that locality. The reefs parallel with the granite ridges extend southwestwardly to near the Barbar Mountains, where they appear to form an obtuse angle with the auriferous reefs, or lodes, that extend (southeast and northwest across Nicaragua) along the foothills of the Matagalpa system of mountains, from the Caribbean Sea to the Pacific Ocean. In the granite hills were discovered two large deposits of iron ores, limonite and hematite, and one deposit of manganese ore, the black di-oxide pyrolusite; also graphite and some tin sulphide, stannite, whether in paying quantities or not, *i. e.*, profitable to mining, has not been determined satisfactorily, because they were found but recently, this year, 1893, in an uninhabited wilderness; they are, however, in a thoroughly mineralized locality. The auriferous reefs are of the Dioritic gold-evolved era (as classified by David Forbes, F. R. S., in his paper "On the Geological Epoch at Which Gold Has Made Its Appearance in the Crust of the earth"),[4] and appear at the surface often where many greenstone rocks were discovered.

The auriferous placer deposits or leads of clays, gravels, sands, gold, and boulders are of different geological epochs, viz.: the strata of partly-cemented auriferous drifts of sands, gravels, etc., exposed in patches, small to several acres, at the sides near the base of the erosion-formed hills and appearing to pass through those hills, and also found in the upper valleys at varying depths beneath the surface and at many places exposed in the banks along the sides of the creeks. These leads of gravel drifts are from 8 to 20 inches thick, and although few masses of gold visible to the unaided eye were observed in them, yet when they had been washed out from a pan there were frequently left in the pan particles, grains, and small nodules of gold, or occasionally laminated small masses of gold of angular, sub-angular, and oval forms. These are "alluvial drifts," or gravel beds, formed during the latter part, I am inclined to believe, of the Champlain epoch, and usually contain only a small per cent of sub-angular and partly rounded quartz. The gold found in them is in rather coarse grains and particles, as described, and evidently derived from three sources:

(a) The auriferous reefs that traverse that part of the country, and—

(b) From the deeply disintegrated granite masses, and—

(c) From the disrupted masses of quartz, pyrites, etc.,

[3]At latitude 12° 20' north from the equator similar moutonned ridges and glacial epoch moraines were discovered on the south side of the southeastern termination of the Matagalpa system of mountain ranges, and were examined by the author of this paper in 1890, and reported on to the British Association for the Advancement of Science, the American Association for the Advancement of Science, and officially to the Government of Nicaragua.

[4]See London Geological Magazine, III., p. 385—7.

that once were enclosed in the moutonnéd ridges, and subsequently eroded therefrom. The gold is believed to be in quantity sufficient to be profitable to mining operations, especially because the mining could be done economically by water, which is convenient, abundant, and has a rapid fall or descent in the nearby creeks.

The alluvial beds of auriferous clays, sands, gravels, and small boulders that are found in the beds of some of the gulches and in the channels of some of the present system of creeks are often partly cemented by hydrous oxide of iron in some places and by silica at other localities. These deposits were commenced, I am persuaded, during the Terrace epoch, and, in some places, are apparently quite rich in gold of rough, semi-angular pieces and in rounded particles; yet some of the particles of gold in the small creeks or nearby dry gulches appear so angular and undisturbed at their edges as to impress one with the opinion that they have increased in size, "grown," where they are discovered by additions from passing solutions containing gold; the chief sources, however, of the gold found in these creeks are the same as those named under the head of reefs or lodes, with additions of gold from the older leads above described found in the upper, and apparently passing through the erosion-formed hills and from accretions of gold deposited from passing auriferous solutions. The bedrock in some of the creeks is an iron-cemented arenaceous argillyte resting on a bed of partly cemented boulders, sands and clays which appear, at one place discovered, probably in the entire locality, to rest on strata of auriferous conglomerates or breccia and this on an auriferous gravel superimposed on a bedrock of metamorphosed shale or slate.

Geological history. We found several obstacles intervening to prevent, at present, that careful examination necessary to determine the geological epoch, when these granite ridges were upheaved and when thereafter they were exposed by the denudation of superimposed strata; during what epoch the regional elevation occurred and the erosion-sculptured hills in that region were formed; from what rocks or sources came the gold found now in the reefs or lodes traversing, longitudinally, the mountains and ridges.

One obstacle is that no ravines or cañons were discovered that deeply enough expose the strata toward the centre of the mountains or ridges.

Other obstacles are, the very deep disintegration, in situ, of the exposed rocks and the deep soil covering the surface and also the dense vegetation, frequently a jungle difficult to cut a pathway through, covering in matted masses even the nearly perpendicular sides of ravines; but, tentatively, and from the clearest examinations we could make, we form the following geological history of this locality.

1. The granite in the hills and ridges was forced up through Jurassic period and later rocks and it upturned to nearly vertical the superimposed strata, in some of which strata were discovered moulds of silica (lined with small crystals of quartz) like the Trigonia Conradi, also others like moulds of Tancredia Warreniana.

The fissures, also the dykes of diorite, appear to have resulted from disturbances occurring in epochs Post-Oolitic, but not extending later than the Cretaceous, this being the latest known or generally recognized time or period during which gold has been conveyed in large quantities or percentages, as a constituent in granites and diorites, up to the earth's crust; these auriferous granites and diorites are certainly abundant in this region and are not Palæozoic nor Cenozoic rocks. The gold in the reefs or lodes has been dissolved from the granites and diorite rocks by hot mineralized waters and deposited therefrom into the fissures or reefs, on cooling or on deoxidation of the solutions, either enclosed in pyrites or as free gold.

The gold in the placer mines, drifts or leads, appears to have been dérived almost entirely from the disintegrated and denuded granites forming the mountains and from the reefs in the mountains; a small percentage of the alluvial gold is, however, from the small areas or patches of auriferous quartz eroded from the moutonnéd ridges, also a small percentage of gold has been deposited from passing alkaline waters that contain gold in solution.[5, 6]

The patches of auriferous quartz found generally at the base of the moutonnéd ridges as if eroded from them appear to have been transported (with the other materials composing the moutonnéd ridges) from auriferous reefs in the ridges forming the southeastern part of the Matagalpa system of mountains.

The boulders of bluish-colored rocks, auriferous and containing a large percentage of pyrites, found quite frequently in that region, are usually some variety of the soda-bearing hornblede rocks like glaucophanyte, although bluish trachytes, also bluish hypersthene boulders, some of them auriferous (probably all of them) were discovered. Some of the very interesting observations noted were: (*a*) The altitude above the Caribbean Sea (aneroid readings) of several of the hills and ridges in the region herein described is from 1,000 to 3,600 feet, consequently the flow of water to the Caribbean Sea, only 90 or 100 miles distant, is very rapid, there being no swamps, only those of brackish water in the delta of the rivers; this rapid descent of water from the mountains over numerous rapids, cascades and falls in the creeks and rivers offers many places where great water power or pressure could be had to move machinery for sawing logs, defibrenating plants, mining, etc.; (*b*) That region, excepting the clay-surfaced moutonnéd ridges, is covered, from two to twelve or more feet deep, with a very fertile soil composed in large percentage of partly decomposed vegetable matter (nitrogenous) and potash and other alkalies and alkaline earths, from the alkali-containing rocks, granite, feldspar, etc. Consequently there are excellent agricultural lands for corn, potatoes, coffee, tobacco, almonds, etc., on the sides of the hills and ridges, and suitable for sugar cane, plantains, bananas, cacao, India rubber trees, etc., in the valleys. Some of the mountain lands are admirable for coffee, and in the upper valley lands, indigenous cacao trees (Theobroma) of good varieties are numerous; (*c*) The climate is warm, but not uncomfortable, no lagoons nor swamps in the hilly region; (*d*) On the mountain ridges grow forests of large trees, among which mahogany, cedar, rosewood, sapote (Ulva sylvestra), iron wood, guanacaste and nispero appear to be the most numerous.

The tunoo trees[7] are also numerous and of large size, and, young vigorous-growing India rubber trees (Syphonia elasticos) are very abandant, while in shaded moist places, the surfaces of disintegrating rocks are frequently covered with the beautiful velvet vine of Nicaragua (first discovered about 1856 in Nicaragua), having

[5]Gold being invariably found in the granitic series of rocks, especially those of Palæozoic and Mesozoic eras and early Tertiary period, should, I am inclined to believe, influence us to recognize the gold as a constituent and not merely an accessory mineral in the rock.

[6]The fact of the existence of gold in rocks of the granite series appears to give support to the theory of the successional deposition of the elements in the [illegible] of greatest sp. gravity being nearest to the earth's centre. Platinum, gold and iron appear to have been brought to the crust of the earth in every upheaval of granitic masma.

[7]The tunoo exudes freely, when scarified, a milky juice appearing like the milk or sap that flows from lacerations in an India rubber tree, but concretes into a gum like gutta percha. The fibrous inner bark is a texture of strong interwoven fibres and can be removed from the tree in pieces as wide as the circumference of the tree (from three to six or six and a half feet wide) and twenty to forty feet long. The Soomoos and Sambos use this bark as bed-clothing and as clothing for their bodies; they prepare the bark for these purposes after removing it from the tree by wetting in water and softening by beating it with sticks, when it becomes soft and remains very strong.

its exteriorly pure, white, trumpet-shaped, velvety flower tinted with various clear colors of purple, golden, pink, etc. Orchids in great variety are numerous, also ferns of all sizes, up to trees twenty feet high, are abundant.

This wilderness contains much undeveloped wealth in its export varieties of trees, medicinal and fibrous plants, and in its undeveloped minerals, metals, and very fertile agricultural lands, and has much to interest scientists, especially naturalists.

July 30.

A NEW REFLECTING AND DIRECT ACTING POLARISCOPE FOR THE ARC LIGHT PROJECTOR.

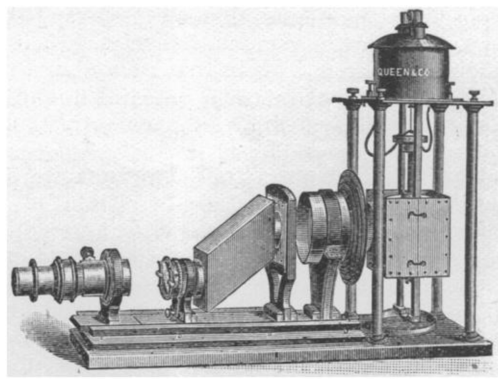
BY OSCAR KNIPE, PHILADELPHIA.

REFERRING to a paper on the subject of Projection, published lately in *Engineering* and several other periodicals, it was then indicated that most of the accessory instruments for Projection, among them the polariscope, would become more popular and find increased employment in the various courses of instruction. The arc light being so convenient, prompt in application and so perfectly satisfactory, suggests, of course, an extended application, and in consequence the expert will frequently find chances for improvement.

The favorite construction of the polariscope has been with Nichol's Prisms, two of these being employed, one for the polarizer and the other for the analyzer. To obtain brilliant effects it is necessary that the former should be at least two inches across the face; unfortunately it is now impossible to obtain such large crystals of spar, and as the demand for these instruments increases very much the reflecting polariscope again comes to the front; the old elbow arrangement furnished by some makers of instruments is a very clumsy attachment and inconvenient, as it requires the projector to be turned side-ways so that the light can reach the screen in front of the audience.

Various modifications have been proposed mainly by London makers and amateurs to obtain a direct acting reflecting polariscope by two opposite surfaces set in a box at the usual angle and deflecting the beam upward or downward, but the main objection, that of being inconvenient, still remained. The optical bench of the Paragon Projector offers, however, special advantages in that respect; the distance from the centre of the arc to the slide base being sufficient to allow a downward polarizer to be adopted, leaving abundant room for the object stage, objective and analyzing prism upon the bench. In practice this instrument is found to be simple in adjustment with the light, and the results obtained are surprising; the field projected is perfectly circular and even, alternating it light and completely dark by rotating the analyzer. The object stage here used is a novel devise; it consists of two uprights which open and close by a spring forming a clamp, a rotating ring with spring clips is secured to each clamp upright, so that three objects can be combined at one time, which is required for circular and eliptic polarization. The stage for exhibiting the phenomena of polarization in crystal, glass forms (verre trempe), and those produced by heating the object will be described at a future time.

The polariscope described above is specially adapted for plane and circular polarization of geometric and fancy designs of Selenite and Mica. The latter is easily obtainable and can be split into laminæ of various thicknesses, the thinnest that can be taken off in a square of about two inches is technically known as an eighth wave plate, the next thickness equal to two one-eighth films superposed is termed a quarter wave film and another equal to two one-quarter films superposed is the half wave film. The quarter and half wave films are the most useful in producing the most marvellous color combinations imaginable, not only in the gay primaries of the solar spectrum, but also in the more quiet grays and plain colors generally; taking a specimen composed of four or six strips of selenite about one-quarter of an inch wide by one and a quarter inches long, laid closely together, it will project its primary colors at once upon the dark field obtained by the position of the analyzer; the slightest turn to the right or to the left produces a change in the colors, but if we move the prism through one-quarter of a revolution the field is changed to a ground flooded with light and the colors have respectively changed to their complementary tint, the carmine has become a pale green, the lemon color an azure blue and so on; they are termed complementary because when superposed they produce white light. Allowing the specimen to remain, we take advantage of the rotary slip in front of our triple object stage and place there another specimen of selenite strips exactly like the first, but place it at right angles or diagonally and we now will have an illustration of the fact alluded to that complementary colors produce white light. The reason that only here and there a square or diagonal of real black or white is produced is found in the difficulty in matching exactly the films. After passing through the various changes, taking a note perhaps of the exact angle at which a certain color is produced so as to be able to repeat it afterward, we will remove the specimen from the front of the stage, and replace it by a quarter wave film; these have generally the axis marked on the edge by an arrow. We shall now obtain a decidedly different set of colors, which con be varied by rotating the analyzer; but notice now that instead of the two complementary colors we have a continual interchange of four or more colors, which can all be registered and repeated. When the quarter wave or half wave film is placed on the rotary clip at the back and rotated we obtain a different set of colors as well as



a colored background. A specimen representing three or four concentric circles, or a wheel divided into a number of sections joining at the centre or again a thin slab of selenite which is ground concave on its face, either of these will give the most beautiful and fascinating changes of color. As these various types of colors are absolute standards taken from the book of nature which can be exhibited precisely alike, it is obvious that we have here in this branch of polariscope study the most brilliant, complete and unchangeable system of color samples with their complementaries and color contrasts which far surpass any book of artificial colors. These when projected on the screen in a class become the objective point of every member, and can be pointed out, and commented upon by the instructor. As the geometric designs may be varied in composition, the mica films being very inexpensive, it requires merely a little patience and experience to produce an unlimited variety. The apparatus described in this article is made by Queen & Co. Incorporated of Philadelphia.

THE SENSE-ORGANS ON THE LEGS OF OUR WHITE ANTS, TERMES FLAVIPES, KOLL.

BY DR. ALFRED C. STOKES, TRENTON, N. J.

In an eyeless creature that habitually shuns some influence in the light, and lives in subterranean passages, or in tunnels or dark fissures within decaying wood, we should hope and rather expect, if we considered the matter solely from the human standpoint, to find either an extra number of sense-organs or a supply of an unusual variety, as a compensation for the absence of sight and for the limitations of a restricted environment. Such human expectations would be realized in the case of the white ants, *Termes flavipes*, so common within the rotting stumps and the fallen branches of our damp woods, for these Platyptera possess what may be considered to be an ample exchange for sight, for they have on all of the six legs a wonderful number and variety of sense-organs, which should certainly meet the needs of a peculiar life, as they doubtless do.

It is generally agreed among naturalists that certain insects, perhaps the greater number, possess some senses different from any owned by man and of which we therefore can have no idea. Sir John Lubbock says, "It is, I think, generally assumed, not only that the world really exists as we see it, but that it appears to other animals pretty much as it does to us. A little consideration, however, is sufficient to show that this is very far from being certain, or even probable."

On each of the legs of *Termes flavipes* there are seven organs which are plainly sense-organs, with three forms of appendages which may be sensory, but are probably ornamental only. The blind, subterranean *Termes*, then, with six legs and with seven sense-organs on each, is right well prepared for whatever may happen, even for the forceps of the predatory microscopist. The forceps conquers in the end, but the insects seem to feel its presence before it touches them, retreating and sometimes backing away from it as from some obnoxious object. Yet upon this apparent fact I should put no great reliance, as the observation was made with a single nest and late in the season, although the lateness of the season would probably have no effect, except to render impossible, as it did, a repetition of the experiment. It may, therefore, have been an event "viewed unequally."

The appendages referred to as being doubtfully sensory are mere elevations of the chitinous walls, ornamental in their arrangement, minute in size, and if possessing any special nervous connections, these have escaped my notice. The appendages, or ornaments, vary much in appearance on the coxa, the trochanter and the tarsus, the femoral and the tibial ones being similar to those on the coxa. On the latter the elevations are simply aculeate, the aculei being exceedingly minute; on the trochanter and on the femur they take the form of minute prickles, which, at first glance, appear to mark out the impressions of the chitinogenous cells, as in Fig. 1, from the femur; on the tibia the elevations become still more aculeate (Fig. 2); they are more widely separated, and the delicately elevated ridge which bears them gives the markings much the aspect of irregular, thick-edged scales, especially at the distal extremity, as in Fig. 3; on the tarsus the change from these clusters of aculei is abrupt, more or less semicircular scales, with thickened and elevated margins taking their place, as in Fig. 4, the edges of these being sometimes minutely denticulate. Viallanes, speaking of the situation of the sensory hairs of insects in reference to the chitinogenous cells, says that there are "two kinds of hairs, distinguished by their size and structure. The smaller spring from the boundary between contiguous polygonal areas, and have no sensory character. The larger ones occupy unusually large areas, surmount chitinogenous cells of corresponding size, and receive a special nervous supply." It is more than probable, therefore, that these minute appendages have in no place a significance different from that possessed by the minute elevations so common on the exo-skeleton of so many insects. But to notice the different form and arrangement on the different portions of the leg is at least interesting and suggestive.

The chitinous bristles, or "hairs" (Fig. 6), have here the usual form, and the structure described by Viallanes, being slightly constricted at base and inserted in a hemispherical depression as a socket-joint, and furnished with a nerve-fibre, of which Viallanes says: "The nerve expands at the base of the hair into a spindle-shaped, nucleated mass (bipolar ganglion-cell), from which issues a filament which traverses the axis of the hair, piercing the chitinogenous cell, whose protoplasm surrounds it with a sheath which is continued to the tip of the hair. Such sensory hairs are abundant in parts which are endowed with special sensibility."* On the legs of *Termes flavipes* these are, as elsewhere, sense-organs of great delicacy, with a sense of touch probably as sensitive as that of man himself.

In the same list with these sensory hairs may be mentioned organs of a similar character and of apparently great importance to the insect, which are found at the distal extremity of each tibia, each leg of the second and of the third pair bearing two, while those of the first pair have three. They are stout thorns, or spurs, projecting, in the first or anterior pair, two from the lower lateral margin of the tibia, with one from the upper lateral border, as shown in Fig. 9, where the other sensory hairs have been omitted.

They are conical organs, measuring about 1-450 inch in length, and are, during life, well supplied with nerve-substance. But that which gives them their unique character is the presence of a more or less circular aperture near the basal or tibial portion of the thick wall, as shown in Fig. 9, and more in detail by Fig. 15, each insect thus possessing no less than fourteen of these peculiar perforations. The circular aperture is externally surrounded by a thick-walled, elevated, marginal ring, and across it, apparently at the level of the general surface of the tibial wall, extends a delicate membrane, supplied with a rather conspicuous, centrally disposed nerve-fibre, as shown in Fig. 15, where a nerve is also delineated as passing from the tissues within the hollow of the spur to the mass of nerve-tissue which is here retracted from the walls, probably by the processes of preparation. Within the mass thus withdrawn ganglion-cells are plainly visible.

What may be the function of these fourteen organs, which are doubtless sense-organs of importance, must be left to the reader to explain. I do not know that they have been previously observed; yet it is more than possible that I may have overlooked some parts of the scattered literature of the general subject. If any plausible conjectures have been published in regard to the function of these or of similar organs, I should be pleased to know what they are, although all such statements must necessarily be conjectural. It is easy to state that certain depressions on the antenna of a bee are auditory or olfactory, but it is quite another matter to do more than to make the assertion. When it comes to the making of experiments to learn the actual function of these minute structures, the obstacles met with are practically insurmountable. But if these tibial spurs of the white ants, with their prominent basal apertures, have been previously studied, and if any probable guessing has been done as to

*Cf. "The Cockroach," by Miall and Denny, p. 30.

their character, I should like to know at what result the philosophical observers have arrived.

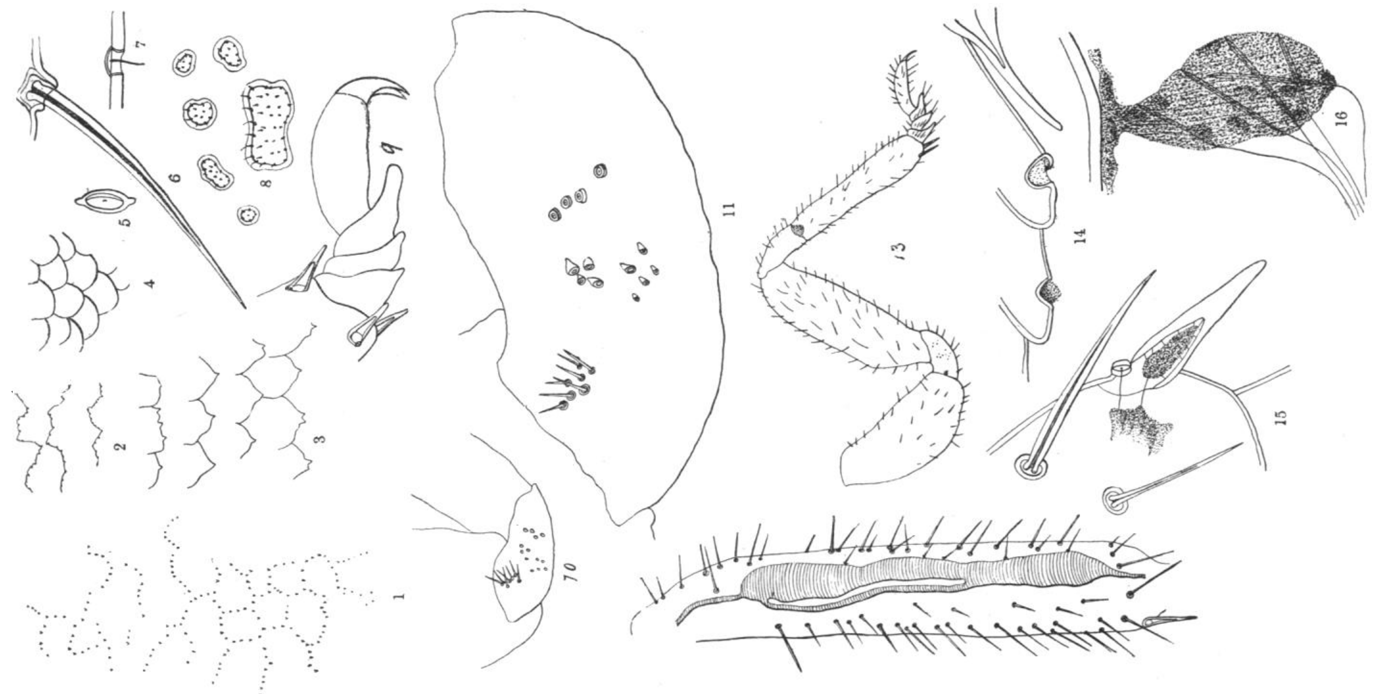
At first glance the organs might be supposed to be auditory, on account of the membrane, which closes them, and the only reason for rejecting such a supposition is that I have not seen any trace of the staff-like rods or the pyriform bodies which Graber found so well developed in what could not be imagined to be anything but organs of hearing in the tibia of the locust, *Locusta viridissima*, and of some other members of the same, or of an allied, order. The auditory organs of our white ants seem to be in an entirely different position and of an entirely different structure.

On the outer wall of the upper, or coxal, end of the trochanter is a group of just seven conical, setose and colorless hairs, surrounded by a circumvallate base, and on the upper outer wall of the coxa is another group of similar hairs, always ten in nnmber, and, presumably, having the same function. These groups are entirely absent from the inner walls. To show its locality, the cluster is exhibited on the trochanter by Fig. 10, and greatly enlarged in Fig. 11.

sides, and are sparingly scattered over the surface of the tibiæ. In Figs. 10 and 11 their general form and usual position and arrangement are shown, although in these particulars they are not constant. The number is also uncertain within known limits, varying on the outer side of each trochanter from thirteen to fifteen, thirteen being the common number; on the femur two and on the upper lateral wall of the tibia, from two to five, with sometimes an unusually large subcentral one, similar to a large one on the inner wall of each tibia; the inner walls of each trochanter also bear from four to five; on the upper part of the femur are from three to four; the central tibial surface has one, and one is near the lateral border of the distal extremity of the tibia.

In structure they closely resemble the circular apertures at the bases of the tibial spurs, each consisting of an elevated ring, having, at the level of the general surface, a delicate membrane furnished with a nerve-fibre, which elevates the centre into a minute but conspicuous papilla. These points are shown in Figs. 5 and 7, the latter being an optical section of a pit.

On the trochanters these organs are arranged somewhat



EXPLANATION OF THE FIGURES.

Fig. 1, surface markings from the femur; Figs. 2 and 3, from the tibia; Fig. 4, from the tarsus; Fig. 5, sensory pit from the tibia; Fig. 6, sensory hair from the general leg-surface; Fig. 7, optical section of a sensory pit; Fig. 8, pilose depressions on the lower end of the tibiæ; Figs. 10 and 11, sensory hairs, pits and hooded pits on the trochanters; Fig. 12, tibial trachea, with recurrent branch; Fig. 13, position of supposed tibial auditory organ; Fig. 14, pits on the lower surface of the first and second segments of the tarsus, one filled with crystalline excretion; Fig. 15, sensory pit at the base of a tibial spur; Fig. 16, tibial auditory organ, partly diagrammatic. All the figures are much enlarged.

These hairs differ widely in size, form, and general aspect from the sensory bristles of the general leg-surface. Underlying them is a specialized group of nerve-cells, which supplies each with a fine nerve-filament.

It is a fact worthy of note that these and other sense-organs are on the outer wall of the various parts of the legs which bear them, and that they either have no representatives on the surface toward the insect's body, or are there smaller and in much less abundance. Even the large sensory hairs of the general leg-surface are much fewer on the inner aspect of the legs.

In addition to these setose appendages, each trochanter bears other sensory organs, which take the form of elevated, circular, or oval rings, surrounding apertures of the same form in the thickness of the walls, some being capped by a conical, often oblique, hood-like membrane. They, as usual, are found chiefly on the external walls of the trochanters, but exist in fewer numbers on the inner

in three groups, according to size, and the three or four largest, resembling flat-topped papillæ pierced with a central depression above the membrane, frequently become confluent, those of the other two groups being capped by a conical, often oblique, hood-like membrane, as shown in Fig. 11. These hooded apertures bear some resemblance to the "canoe-cells" of certain authors, and which are said by Huxley to be only ordinarv pits over-arched by a fine hair. In the present case, however, there is no arching hair, but a distinct hood-like elevation, which is especially conspicuous on the trochanters of the soldier.

It is reasonable to suppose that the capped depressions have a function differing from that of the flat-topped papillæ on the same surface. Those without the hooded covering seem analogous to the sensory pits discovered on the antennæ of certain plant-lice by Dr. John B. Smith, of Rutger's College (*Science*, Jan. 20, 1893). A rather hasty

examination of the antennæ of the white ants does not reveal pits of any kind on the surface, although I am not prepared to say that they are not there. Dr. Smith also found on the posterior tibiæ of the plant-lice a series of the pits, exactly similar in structure, he says, to those of the antennæ in the male. Their function in *Termes flavipes* is as problematical, as Dr. Smith remarks in reference to the sensory pits of the plant-lice. They are present in both the workers and in the soldiers of the white ants, varying in the latter as they vary in the workers.

Perhaps the most interesting of these sense-organs, by reason of their position and of their probable character, are certain depressed spaces, several of which are on the tibiæ, and one on each of the first two segments of the tarsus, where the parts come in contact with the surface over which the insect may walk. With every step taken, these sense-organs perform their work, and probably leave on the surface walked over traces of the presence of their owners, as may readily be imagined, to impress the senses of those that follow. In all this remarkable collection of sense-organs there is none that seems to explain so clearly its reason for being as do these. Yet my supposition that they leave some special evidence of their owners' former presence which shall be manifest to the other members of the insect community, is based upon the observation of appearances in the tarsal organs of some individual *Termes* which are not apparent in those of others. This is that the deep depressions always present on the first and second segments of the tarsus are sometimes filled with a crystalline mass, which projects beyond the general surface as a hemispherical protuberance, especially, as it now seems, late in the season, and with presumably old subjects, thus suggesting the idea that the tarsal organs, at least, are glandular in function, and that the crystalline substance is the hardened secretion collected through abnormal, or sluggish, action of the parts.

On the tibiæ the organs referred to are shallow depressions in the wall, bordered by thickened margins, and with the plane surface of the shallow studded with delicate, exceedingly minute hairs, whose tips project slightly beyond the general level, and necessarily come in contact with any surface over which the insect may walk. The tibial depressions, while they are always present, are not always of the same outlines or of the same number. In some instances there may be one large depression with several small ones scattered about, as in Fig. 8, or the single large depression may be divided into several smaller portions, which shall be scattered over the region without any regularity of arrangement.

On the first and second segments of the tarsus the organs are always present, and always in the same position on the surface which must come in contact with the ground. Each of the two segments bears one in the form of a thick-walled, deep, hemispherical pit, the smooth inner surfaces of which are also studded with fine hairs similar in appearance to those of the tibial depressions, and with presumably the same functions. It is these hollows that are in manv specimens choked with the crystalline excretion already referred to, and shown in Fig. 14, where one pit is filled and the other apparently in its normal condition. Each is plentifully supplied with fine nerve-fibres. Not rarely there are two pits, instead of one, on one or the other of the two segments; in a single instance, I have seen three on the second joint. But these hairy hollows deserve more extended investigation by some microscopist that may be more conveniently situated for that work than I am, and that may have the resources of a laboratory at his disposal.

To such an investigator, thus fortunately situated, the internal structure of these remarkable legs will also offer important subjects for examination. This is especially true of what I suppose, for reasons to be mentioned hereafter, to be the insects' auditory organs, one being present in each tibia, a supply of internal ears that would seem to be more burdensome than necessary or agreeable. (Fig. 13.)

It is possible that these organs may have some connection with the tracheæ, although that connection cannot be close; yet here, as in some other insects, the tibial tracheæ are specially notable on account of the sac-like enlargement of the upper and of the lower ends of the main tube, and of the presence of a smaller, recurrent branch, which leaves the upper inflated portion to enter near the lower at a varying distance from the extremity. This structure has been observed in the locust (*Locusta viridissima*), the cricket (*Gryllus campestris*), and in various Orthoptera by Graber; while Sir John Lubbock describes a similar arrangement in the tibiæ of the ants, especially in *Lasius flavus.* This tracheal structure is well developed in all the tibiæ of *Termes flavipes*, varying in the length of the recurrent branch and in the more direct or more undulating course of the main trunk of the trachea. In Fig. 12 is shown the appearance in one of the tibiæ of the white ants.

In the locust (*Ephippigera vitium* Serv.), according to Graber, and in certain other Orthoptera, the main tracheal trunk bears a collection of ganglion-cells and globules supposed to be auditory in function, at least in part, and which, if present in *Termes flavipes,* have escaped my notice. Yet in each tibia of this insect, situated near the outer wall of each, between it, the nerve and the trachea, is the more or less ovate organ referred to, the structure of which bears considerable resemblance to that of what has been accepted as a tibial auditory organ in certain of the Orthoptera. Its position near the upper third of the tibia of *Termes flaviges* is shown in Fig. 13.

It is connected with the nerve, and is itself formed of a collection of ganglionic cells and globules, with plainly developed, staff-like bodies, the apical extremities of which are conical, and through the middle of their apparently hollow length passes what seems to be a fibre, presumably a nerve. The external extremity is continuous with a nerve-fibre, five of which, with as many elongated, staff-like bodies, being easily made out, the nerves passing singly and separately up toward the femero-tibial joint, near which they are lost to view, especially after my imperfect methods of preparation.

Similar organs have been discovered by Graber in the tibiæ of the Locustidiæ, and by Lubbock in those of certain ants. In reference to the latter, Lubbock says: "At the place where the upper tracheal sac contracts there is, moreover, a conical striated organ, which is situated at the back of the leg, just at the apical end of the upper tracheal sac. The broad base lies against the external wall of the leg, and the fibres converge inwards. In some cases I thought I could perceive indications of bright rods, but I was never able to make them out very clearly. This also reminds us of a curious structure which is in the tibiæ of the Locustidiæ, between the trachea, the nerve, and the outer wall. * * * On the whole, then, I am disposed to think that ants perceive sounds which we cannot hear."

In *Termes flavipes* its position is somewhat different, although its situation and its structure are essentially similar to those referred to by Lubbock and by Graber. It is an organ of fibres, of ganglionic cells and globules, the latter being large and nucleated, and of the long, staff-like bodies already referred to. A partly diagrammatic sketch of the organ is shown in Fig. 16, its outer, narrow extremity being attached to the wide nerve just within the external wall of the tibia and the broad base directed toward the external wall of the trachea.

The rod-like bodies bear a rather remote resemblance to some observed by Graber, in what he considers to be

the auditory organ of the locust, although in the *Locusta viridissima* there are also others broadly clavate and surrounded by a plainly delimited, granular substance.

In *Termes flavipes* there are no external appendages to suggest an auditory function, as there are in the locust and in some other insects, there being here only a slight concavity of the wall over the internal organ, and two or three of the sensory pits scattered about the surface. If the similar organs among members of the Orthoptera have such a function, it seems not unreasonable to suppose that such may be the use of these appendages within the tibiæ of our common white ants.

But, however this may be, the legs of these insects merit careful investigation by some competent observer, so situated that he may have access to all the luxuries of modern microscopical research, most of which are at present beyond my reach, my paper being, therefore, necessarily superficial and imperfect.

LETTERS TO THE EDITOR.

***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

THE OSAGE RIVER AND THE OZARK UPLIFT.

MR. ARTHUR WINSLOW's account of the Osage river and its meanders in *Science* for July 21, 1893, commenting on my previous suggestion concerning the development of that river in *Science* for April 28 of this year, has only lately come to my attention in looking over papers accumulated at home during vacation absence. It raises several questions on which discussion may prove of interest.

In explaining the existing meanders of the Osage and other deep-valleyed rivers of Missouri and Arkansas, Mr. Winslow maintains that the rivers had originally curved courses consequent on the form of the land on which they were initially formed; that these irregularities of flow are still perceptible, although they have been increased during the down cutting of the valleys; and that the down-cutting of the valleys and the general sculpturing of the region now going on is in consequence of an uplift that was essentially completed in Paleozoic time. I am not sure as to my correct understanding of the third point, although such appears to be Mr. Winslow's meaning.

The explanation that was suggested in my article included a long lost beginning of river development in Missouri; the attainment of an oldish topographic condition in the cycle of denudation preceding the present cycle; and an inheritance by the rivers of a meandering course, normally characteristic of the wide-open valleys of the preceding cycle, in the deep-sunk valleys of the present cycle.

Mr. Winslow's first point—that the existing meanders are simply exaggerations of initial consequent river courses—seems to me inadmissable for several reasons. In the first place, this involves the persistence through all of Mesozoic and Tertiary time of relatively trivial peculiarities of river courses, begun on the surface of the carboniferous strata about the close of Paleozoic time. It is certainly true that rivers are long lived, but it is very unlikely that the land history of Missouri has been so simple as to allow so extraordinary a perpetuation of relatively small river features. My reason for this opinion is not simply an *a priori* objection to the opposite view; but a careful examination of the developmental changes of other rivers. In Pennsylvania, for example, the changes in the course of rivers during a period corresponding to that of the land history of Missouri has been so great that I cannot think that the rivers of Missouri still maintain any close trace of their ancient initial courses down to these modern days. It is true that there has been much greater opportunity for variation of river courses among the tilted rocks of Pennsylvania than upon the nearly horizontal strata of Missouri; but to conclude that even in the latter region there have been no essential changes of river courses since the end of Paleozoic time implies to my mind altogether too passive a conception of post-Paleozoic time. It is impossible to say exactly what has happened, for the records are rubbed out; but to conclude that practically nothing has happened in the way of oscillation and warping and river change seems to me the most unlikely of all plausible conclusions.

In the second place, the postulate that the present meanders are directly descended from originally irregular consequent courses does not well accord with the distribution of deep meandering valleys in other parts of the world. They are not found in regions of one cycle of development; that is, in regions that are now in process of degradation following their first uplift. They characterize regions which for other reasons—of which more below—must be interpreted as having a composite topography; that is, having topographic features produced in two or more cycles of degradation. Moreover, the fact that the radius of the valley meanders is greater where the rivers have great volume is not consistent with the origin of the meanders from a control so irrelevant to river volume as the constructional inequality of the original land surface must have been.

Mr. Winslow's second point—that the existing meanders are increased in sinuosity over some former condition of meanders—seems to be an important correction to my brief explanation. It is a point that I had not in mind at the former writing; but in now recalling the form of the meandering valley of the North Branch of the Susquehanna in northeastern Pennsylvania, I see that the correction applies there as well as in Missouri. One might at first suppose that if a meandering river were uplifted, it would tend to straighten out its course, on account of gaining a stronger current; but it also seems possible that an even uplift with no change of grade (except by the action of the river itself in cutting down its channel towards the new base level) may even provoke an increased meandering, instead of straightening out former meanders. Professor J. C. Branner has in a letter called my attention to essentially this interpretation of certain deep meandering valleys in northern Arkansas.

As to Mr. Winslow's third point—that the present valley-making Missouri is the incompleted work of the denudation begun at the end of Paleozoic time—I cannot agree to this at all. Indeed, such a conclusion appears to me so improbable, and so contrary to both local and general evidence, that I fear it is not a correct statement of Mr. Winslow's meaning. He says: "The sculpturing of the topography [of Missouri] must have been uninterruptedly in progress from the end of the Paleozoic to the present time." He implies that the present altitude of the Osarks above the margin of the Tertiary strata in southeastern Missouri is the same as the altitude that the Osarks had above the waters in which the Tertiary strata were deposited; thus excluding all chance of tilting and local warping since that time. Differential movements have been determined even as late as in Tertiary and post-Tertiary time in the west; and there is good evidence of similar late geological movements in the Appalachians along the Atlantic slope. It therefore seems entirely improbable that Missouri should have taken an attitude at the close of Paleozoic time from which it has not since significantly changed and entirely impossible, if

it had done so, that so little advance in denudation of the uplifted mass should have as yet been accomplished. There is every indication that before the close of Paleozoic time, the region which we now call Missouri suffered many oscillatians of level, for its strata are varied in composition and are separated by slight unconformities. The unconformable superposition of the Cretaceous and Tertiary strata of the Mississippi embayment on the denuded surface of the deformed Paleozoic rocks indicates that changes of level and warpings occurred during and after Mesozoic time not far from the region under consideration. In the absence of direct evidence of actual stability, moderate oscillations of level through vertical distances of a few hundred feet, or perhaps as much as a thousand feet, with slight warpings involving slants of a degree or two, should, I think, be regarded as characterizing the post-Paleozoic history of Missouri, as well as its Paleozoic history.

Just when the post-Paleozoic oscillations occurred, and just what was their amount is not determinate; but the latest important oscillation of the series is the one to which I would refer the permission of the rivers to cut their present deep valleys. The various brief and subordinate oscillations associated with glacial invasions and deposits of loess are complicated beyond clear understanding at my distance from their local evidence.

But oscillations being neglected, if Missouri had had only one cycle of denudation since its uplift at the end of the Paleozoic, it could not still be a highland. If the present altitude of the Ozark uplift with respect to its surroundings had been taken at the end of Paleozoic time, as Mr. Winslow supposes, why is it not all consumed now? The sufficiency of subaerial erosion to reduce great uplifts to lowlands in less than the whole of post-Paleozoic time is, I believe, well demonstrated. I do not mean to say that this demonstration is generally accepted; for curiously enough, there is a prevailing hesitation of belief on this subject. Geologists have not as a rule given the matter much attention, but this does not weaken the validity of its demonstration. Those who have carefully looked into the matter, are, I think, convinced of its correctness. Others with whom I have talked on this question, having their own special studies in other directions, have expressed a general incredulity about it, doubting that Mesozoic time was long enough to wear down mountains to peneplains; but their doubts have not taken the form of effective argument. Such doubts might have more value if we had not in many well-known deposits of stratified rocks, the direct evidence of the sufficiency of erosive forces to accomplish great results within definitely limited divisions of the geological time scale; and if we had not sufficient studies of land forms to show that even a part of post-Paleozoic time is long enough to baselevel uplifted masses. Referring only to examples with which I am personally familiar, I may mention the following districts as instances of effective base-levelling within determinate geological periods:

The plains of the upper Missouri, about Fort Benton, Montana, consist of Cretaceous strata, having a broadly rolling surface of slight relief over large distances; but here and there, surmounted by lava-capped mesas, or by necks and thick dikes of lava, whose present position can only be explained by supposing that the strata of the surrounding plains once rose at least as high as, if not higher than, these eminences. Yet this greater mass is now reduced to a peneplain; and since its reduction to a peneplain, it has been uplifted by a considerable amount, and the present trench-like valleys of the Missouri and its branches have been cut down two or three hundred feet. All this has happened since the deposition of the Cretaceous strata, of which the plains are there built. It is true that the strata of the plains are not particularly resistant; but neither are those of the Missouri plateau.

The Triassic formation of Connecticut and New Jersey has been base-levelled since it was faulted and tilted from its original horizontal position. Since it was base-levelled the resultant peneplain has been again uplifted, and its sandstones have been reduced to a second base-level, while its very resistant trap rocks retain, more or less perfectly, in their crest lines an indication of the altitude to which the older peneplain was elevated. The first work of denudation, by which even the trap sheets and the adjacent crystalline rocks were effectively base-levelled, was a post-Triassic work; the second denudation, by which only the weaker sandstones were base-levelled, is roughly dated as post-Cretaceous. The base-levelled sandstones are now trenched, in consequence of a late, or post-Tertiary, uplift.

In Pennsylvania the mountain ridges that are generally described as the remnants of the Appalachian or post-Carboniferous folding and uplift, cannot be legitimately so considered in the light of existing evidence. Their extraordinarily even crest lines, entirely out of accord with their folded structure, but closely in accord with one another, can be interpreted only as surviving indications of the peneplain to which the whole mountain system was reduced while the region stood lower than it now does; and the wide open valley lowlands between the ridges are the product of denudation since the uplift of the peneplain. These valley lowlands are trenched by the streams, in consequence of a still later uplift. The dates of these features are apparently identical with their relatives across the Delaware in New Jersey.

The upland of the Appalachian plateau in western Pennsylvania is a surface of denudation, trenched by valleys. The upland is accordant in altitude with the even crest lines of the Appalachian ridges.

The Hudson River flows through its crystalline Highlands in a deep, steep-sided valley. Further up stream, above Newburgh, where the rocks are weaker, the valley is opened into a broad lowland. Both the gorge of the Highlands and the open valley lowland further up stream are the work of post-Cretaceous erosion, and probably of less than all of Tertiary time. The valley lowland is trenched, indicating a late Tertiary or a post-Tertiary uplift.

Examples of this kind might be increased in number from the western surveys, but I shall leave observers there to speak for themselves. They all teach one lesson, namely, that in rocks of moderate hardness Tertiary time was amply long enough to allow the formation of wide open valleys, even to produce peneplains of faint relief on such rocks as the Triassic sandstones of New Jersey, the Paleozoic shales and limestones of Pennsylvania, or of the middle Hudson valley. It was long enough to form narrow valleys in rocks of excessive resistance, like those of the Hudson Highlands.

Is not this conclusion applicable to Missouri? The rocks along the Osage are not of notable resistance. How, then, can its valley slopes be steep if they are so old as all of Mesozoic and Tertiary time! That measure of time has elsewhere easily sufficed to wear out highlands into lowlands, to uplift them again, and enter well upon their second effacement. How, then, can Missouri be still so little advanced in the sculpturing of its topography, except by reason of the relatively recent renewing of the task! It seems to me utterly impossible to explain the valleys of Missouri as a product of one geographical cycle; the product of sculpturing that has been "uninter-

ruptedly in progress from the end of the Paleozoic to the present time."

Having thus far taken the negative side on some of Mr. Winslow's propositions, I will now turn to the positive side of the argument in support of my own views.

Enough has been said to show my reasons for thinking that the initial courses of the drainage on the Paleozoic strata at the time of their first emergence are long since lost. Let me now consider the evidence of composite topography in the Ozark plateau, and the evidence that indicates an uplift between the production of the more gentle forms of the upland and the steeper slopes of the Osage valley and its fellows.

The Missouri reports frequently make mention of the relatively even surface of the upland country, and its contrast with the steep sides of the ravines in which the streams now flow. The upland is not level by any means, but has gentle swells and broad slopes, distinctly unlike the sharper slopes of the ravines. The process by which the present ravines are forming is not a direct continuation of the process by which the gentler slopes of the upland were formed. The former are incised in the latter; the latter have suffered little change during the excavation of the former. What, then, is the origin of the upland? It is not a constructional form; that is, it does not retain the form of strata deposited under water and simply uplifted into a land surface. It has manifestly been eroded, and thereby changed from its original constructional form. Under what conditions can a gently rolling surface be formed by erosion? Only as the penultimate result of long erosion, whereby the initial valleys have been deepened close to base-level and widened so as almost to consume the intervening hills; that is, the rolling upland must have gained an oldish topographic stage, when the erosive forces were acting with respect to a base-level different from that which now controls them, and with respect to which they are trenching deep valleys in the upland. The region must have stood lower when the wide rolling uplands were fashioned than it does now, when the upland is incised by steep-sided valleys. The change of elevation, by which the older cycle was closed and the present cycle was opened, was only long enough ago to allow the excavation of narrow valleys in rocks of moderate hardness; and hence, according to the time scale above indicated, this uplift was not longer ago than somewhere about late Tertiary time. The uplift revived the oldish streams that then flowed gently in wide open valleys, and the streams at once began their new task of cutting down their basins towards the new base-level. They have not yet done much in this new task.

It is only as a part of this new task that the Osage has cut down its meandering valley. Making all allowance for increase of meanders during the deepening of the present valley, the river must have possessed significant meanders when the down-cutting was begun. Such a conclusion is quite consistent with the conclusion of the preceding paragraph; for a meandering course is generally characteristic of an oldish river, such as the Osage was when it was flowing across the formerly lowland surface of what is now the upland. I am therefore constrained to think that more than one cycle of development must be postulated in explaining the course of the Osage through the Missouri plateau.

Regarding the relations of the meanders of the upper branches of the Osage on their open flood plains and those of the lower course of the main stream in its deep valley, I am not confident that the suggestion of my former article is correct. Mr. C. F. Marbut, lately of the Missouri Geological Survey, now a student in our Geological Department, and of whose topographical work Mr. Winslow made mention, tells me that the wide valleys of the upper Osage are confined to the weaker strata of the Coal measures; and that the narrower valley of the lower stream occurs in the harder lower Carboniferous and older Paleozoic rocks. This introduces a complication in the problem that cannot be safely solved at this distance from the field; but a review of the topographical maps with this fact in mind gives no reason for withdrawing from the conclusion that the region has been pretty well base-levelled before the existing valleys were cut in it.

Several points that Mr. Winslow makes regarding the

Tertiary beds of the Mississippi embayment and the gravels within the Missouri valleys, I shall not attempt to consider, as they should be seen on the ground before being discussed. As far as presented, they do not overcome the various lines of evidence which point to changes in the level of Missouri since its Paleozoic emergence; the last of these changes being the one in consequence of which the present valleys were cut in the denuded surface of the region.

W. M. DAVIS.

Harvard College, Oct. 31, 1893.

COON CATS.

SEEING Mr. J. N. Baskett's note on page 220 of the current volume of *Science*, concerning coon cats, I venture to inform you that I was struck with the extraordinary appearance of one of these cats owned by Mr. Will Carleton, who had it with him in the Catskill Mountains the present summer. I asked him about the cat and he told me the same fable which Mr. Baskett relates, but he went on to say that of course the story was incorrect and that in his opinion this peculiar race of cats from Maine is descended from some Perisian or Angora breed brought down to Maine by early French settlers from Canada. I believe that this was surmise on Mr. Carleton's part, but it seemed reasonable to me and if you receive no more satisfactory explanation in reply to Mr. Baskett's question, you are at liberty to use this.

L. O. HOWARD.

Washington, D. C., November 9.

PUMP WATER.

IN America we often observe that the farmer, in his efforts to economize the steps of the housewife, digs his domestic well in close vicinity of his drains and outbuildings, but I have yet to see at home so pronounced a case of unsanitary surroundings as I observed in Germany a short time ago.

The top of a tall wooden pump, which crowned the family well, just peeped out from a huge manure heap which completely surrounded it. So large was the heap that the pump handle had to be operated by a rope, and the water was carried beyond the heap by a small trough.

WM. P. MASON.

Rome, Italy, Nov. 2.

COON-CATS.

IN answer to Mr. J. N. Baskett's question regarding "Coon-Cats" in your issue of Oct. 20, 1893, I would say that this cross-breed of animals has been known for many years, more particularly in the State of Maine. The error attributing these mongrels to a cross between our domestic feline, and the raccoon, *Procyon lotor*, is as general as it is ridiculous; for it stands to reason that animals of different families could not interbreed. The notion is about as ridiculous as a prevalent story among the ignorant that (cat) owls bear their young alive.

The subject of "coon-cats," or sometimes called mule-cats, has been repeatedly discussed in many papers, and it is now generally conceded that this hybrid is the result of an alliance of our domestic tabby with some Oriental feline—probably the Angora. This cross would show the long, bushy tail of the Oriental species. But Mr. Baskett is in error in supposing these animals plantigrade, and if he secures a skull, which he can easily do, he will find that the dentition is pronouncedly feline.

These cats are quite common in parts of New England, and may be purchased at a very reasonable figure, and according to the demands and the supply in the cat market. Few persons are able to distinguish between genuine Angoras and these hybrids, and many are the unsuspecting buyers who have paid a high price for a common "coon-cat" worth not more than two dollars.

MORRIS GIBBS.

EXCHANGES.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For Sale.—A very fine telescope, length extended, twenty-five inches, closed, seven inches. Power twenty-five times. Good as new. Cost $25.00. Will sell for the best cash offer. B. S. Bowdish, Box 165, Phelps, N. Y.

For Sale or Exchange for last editions of Standard Works on Vegetable Anatomy or Physiology: Practical Zoology, Marshall & Hurst; Elements of Embryology, Foster & Balfour; Zoology, Macalister; Guide to the Study of Insects, Packard; Geological Studies and Shall We Teach Geology, Winchell. Also have duplicates of Experiment Station publications which would like to exchange for any not in my file. L. R. Jones, Burlington, Vt.

For exchange.—Skins of Aegialites nivosa, Ereunetes occidentalis, Aunnodramus Arldingi. A. rostratus, Chamara fasciata henshawi, etc., for native or foreign skins with full data. Send lists. A. W. Anthony, 2042 Albatross st., San Diego, California.

I have a Beck New National monocular microscope, accessories, microtome, mounting material and a large number of fine slides. Will exchange the whole or in part for a first class type-writer or photograph outfit. A. C. Gruhlke, Waterloo, Ind.

Offered sidebloom eggs of Bulimus oblongus and exotic land and freshwater shells in exchange for Helices not in collection. Send lists to G. K. Gude, 5 Gresbach Road, upper Holloway, London, England.

Would like to exchange 100 specimens of Canadian Indian Relics for a photo outfit. E. J. Waters, 33 Hoffman St., Auburn, N. Y.

Wants.

WANTED.—Tuckerman's Geneva Lichenum and Carpenter on the Microscope, Wiley's Introduction to the Study of Lichens. State price and other particulars. Richard Lees, Brampton, Ont.

WANTED.—Icones Muscorum by W. D. Sullivant, with or without Supplement, but both preferred. Address, stating price and condition of books, Dr. G. N. Best, Rosemont, N. J.

WANTED.—A copy of Mascart & Joubert's Lessons in Electricity and Magnetism, Vol. I. Address R. W. Clawson, Vanderbilt University, Nashville, Tennessee.

CHEMIST.—Graduate of a polytechnical school, and studied photographic chemistry in Germany and Austria. Situation teaching or in analytical or experimental laboratory. M. B. Punnett, Rochester, N. Y.

WANTED.—A recent college graduate to assist in editorial work on Science. Those seeking large emoluments need not apply. N. D. C. Hodges, 874 Broadway, New York.

A GRADUATE in medicine, experienced, will prepare or revise scientific and medical manuscript for publication, read proof, compile bibliographies, &c. Will also consult New York libraries for persons out of town wishing references to rare works. Address M. D., 104 Cambridge Place, Brooklyn, N. Y.